

Chapter 1

Elements of Modern Networking

Lecture 1

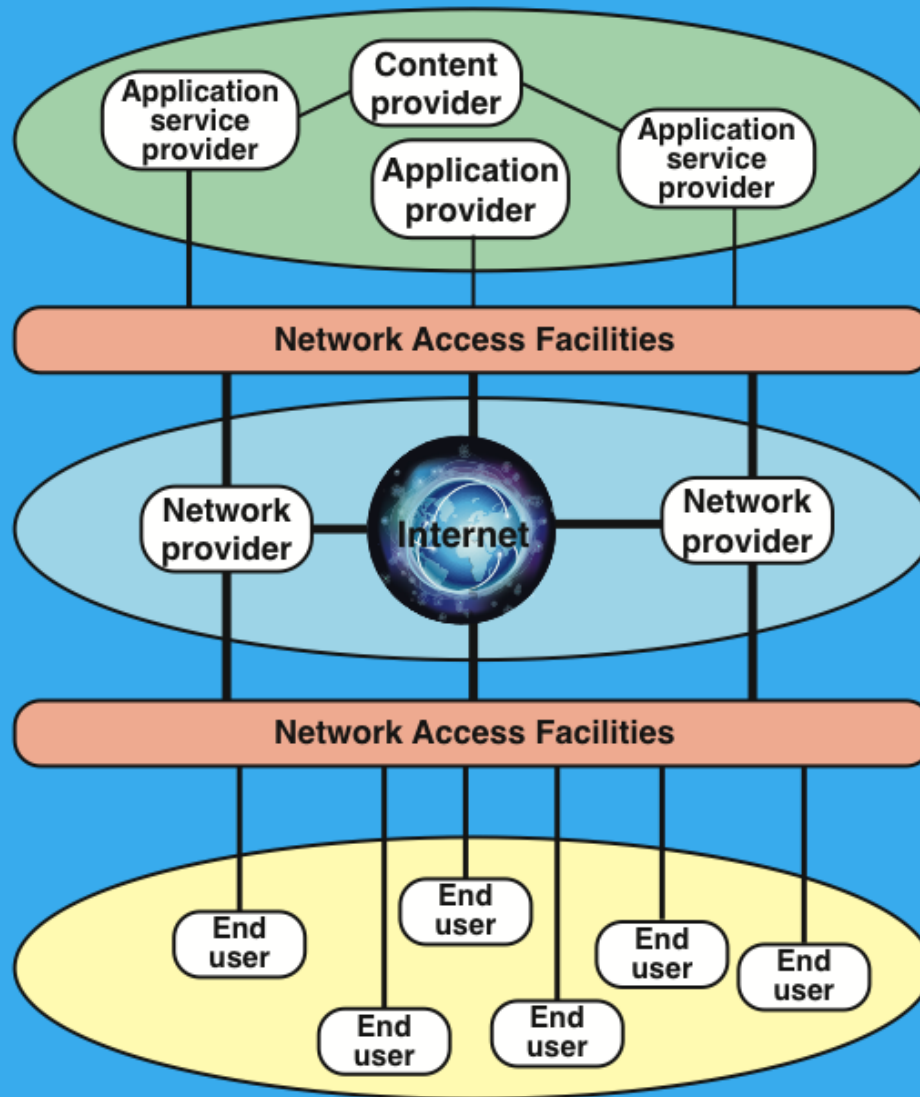


Figure 1.1 The Modern Networking Ecosystem

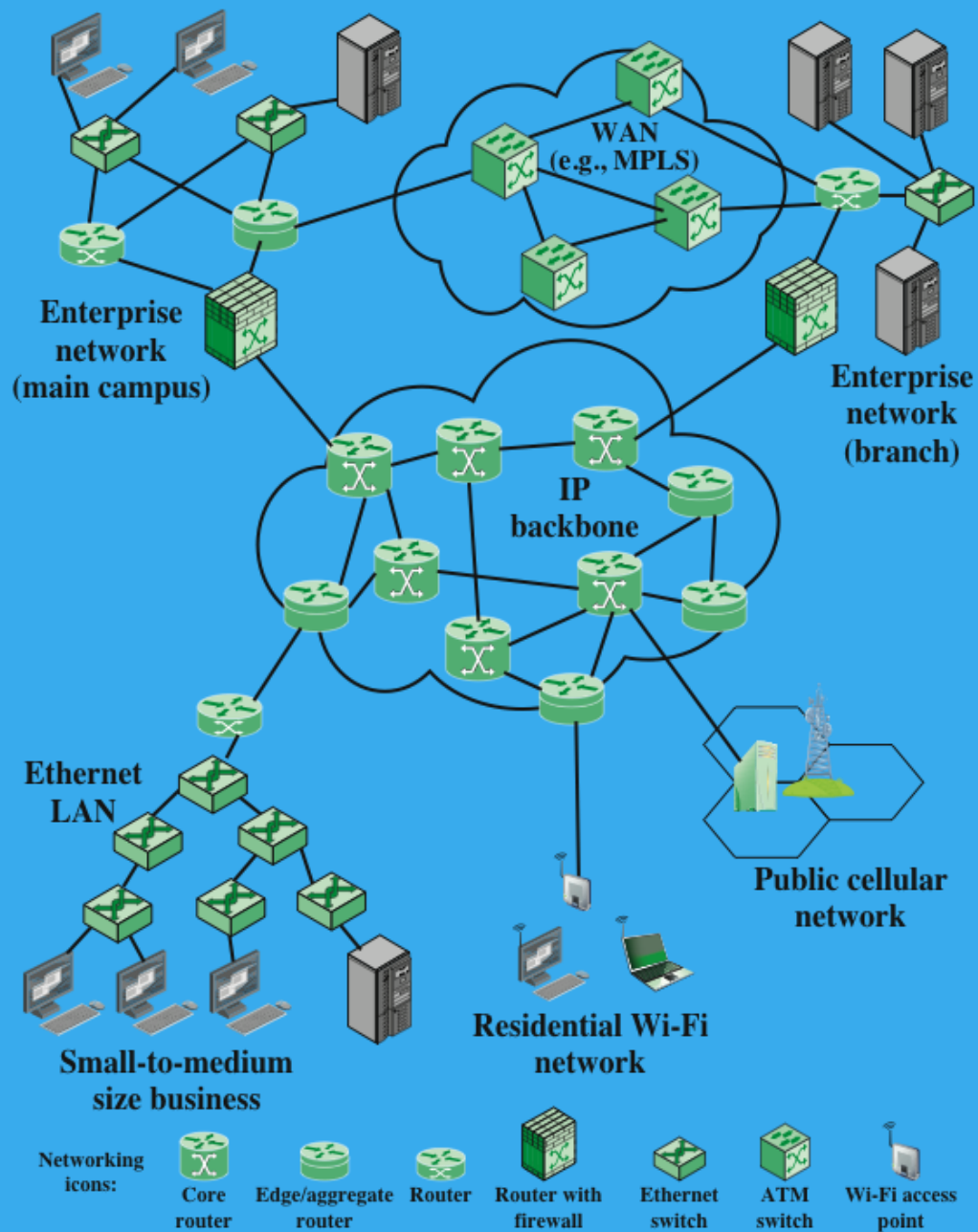


Figure 1.2 A Global Network Architecture

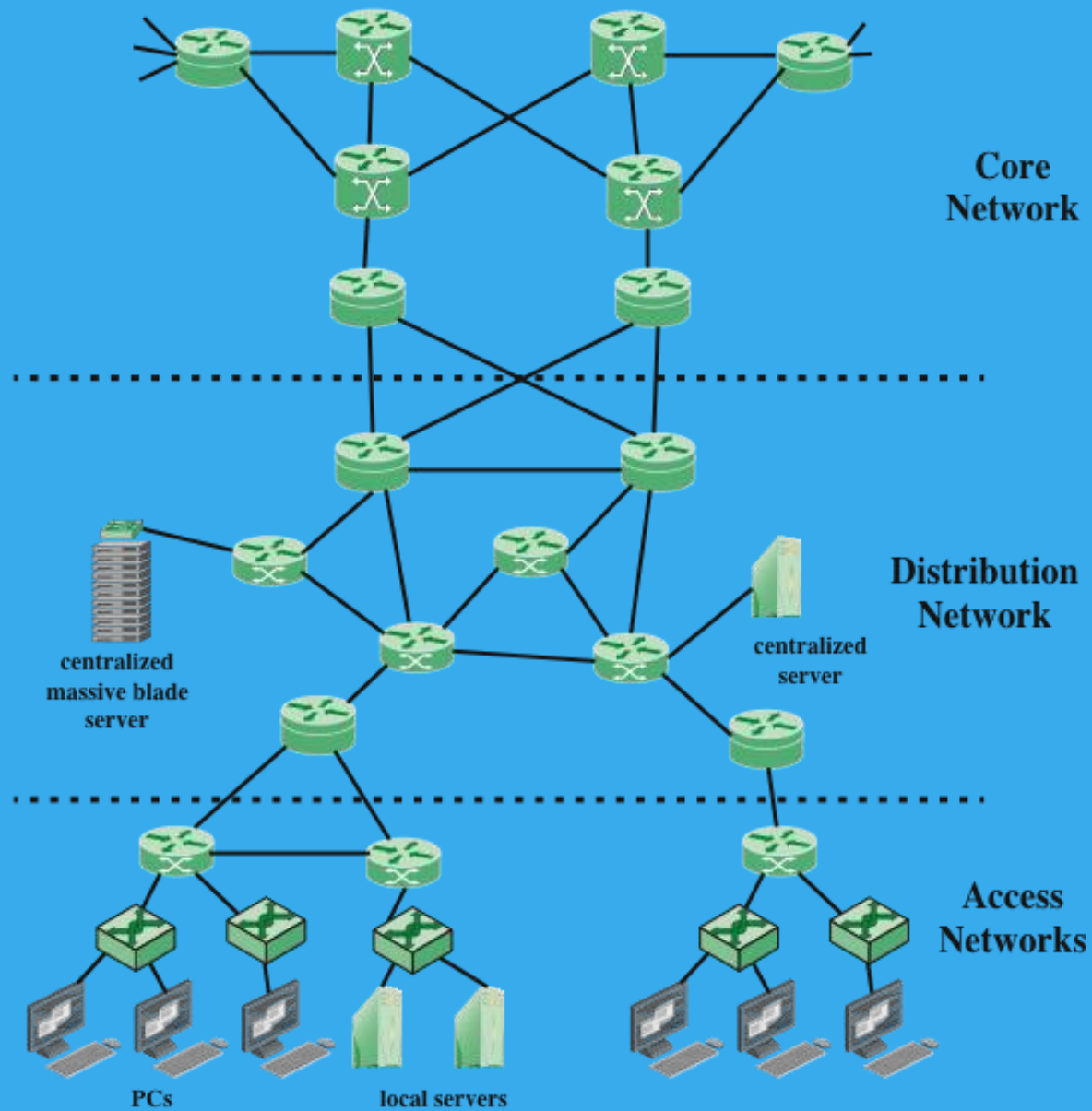


Figure 1.3 A Typical Network Hierarchy

Ethernet

- Predominant wired networking technology
- Has evolved to support data rates up to 100Gbps
- Supports distances from a few meters to tens of kilometers
- Has become essential for supporting personal computers, workstations, servers, and massive data storage devices in organizations large and small

Ethernet in the Home

- Has been used to create a local network of computers with access to the Internet via a broadband modem/router
- Has declined with increasing availability of high-speed, low-cost Wi-Fi
- Two recent extensions of Ethernet technology have enhanced and broadened the use of Ethernet in the home
 - Powerline carrier (PLC)
 - Power over Ethernet (PoE)

Ethernet in the Office

- Has been the dominant network technology for wired local-area networks (LANs) in the office environment
- Wired Ethernet technology exists side by side with the wireless Wi-Fi technology

Retains its popularity because:

It can support many devices at high speeds

Is not subject to interference

Provides a security advantage because it is resistant to eavesdropping

A combination of Ethernet and Wi-Fi is the most common architecture

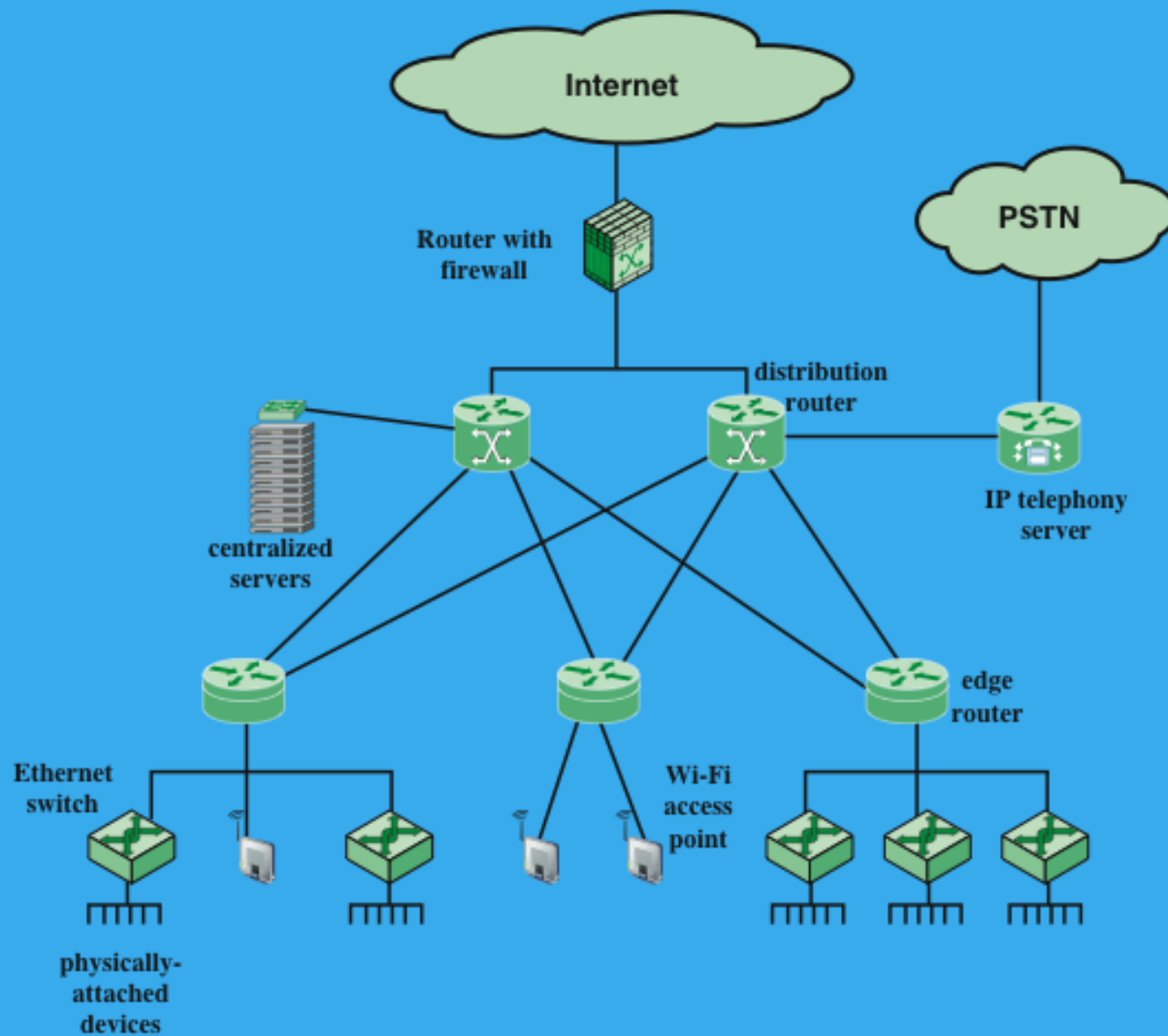


Figure 1.4 A Basic Enterprise LAN Architecture

Ethernet in the Enterprise

- Tremendous advantage of Ethernet is that it is possible to scale the network, both in terms of distance and data rate with the same Ethernet protocol and associated quality
- An enterprise can easily extend an Ethernet network using a mixture of cable types and Ethernet hardware
- Because all the hardware and communications software conform to the same standard it is easy to mix different speeds and different vendor equipment

Ethernet in the Data Center

- Has come to dominate in the data center where very high data rates are needed to handle massive volumes of data among networked servers and storage units
- For co-located servers and storage units, high-speed Ethernet fiber links and switches provided the needed networking infrastructure
- Backplane Ethernet
 - Runs over copper jumper cables that can provide up to 100 Gbps over very short distances
- Blade servers
 - Multiple server modules housed in a single chassis

Ethernet for Wide-Area Networking

- Until recently Ethernet was not a significant factor in wide-area networking
- Gradually more telecommunications and network providers have switched to Ethernet from alternative schemes to support wide-area access
- Other wide-area options
 - Dedicated T1 lines
 - Synchronous digital hierarchy (SDH) lines
 - Asynchronous Transfer Mode (ATM)
- Carrier Ethernet
 - One of the fastest-growing Ethernet technologies

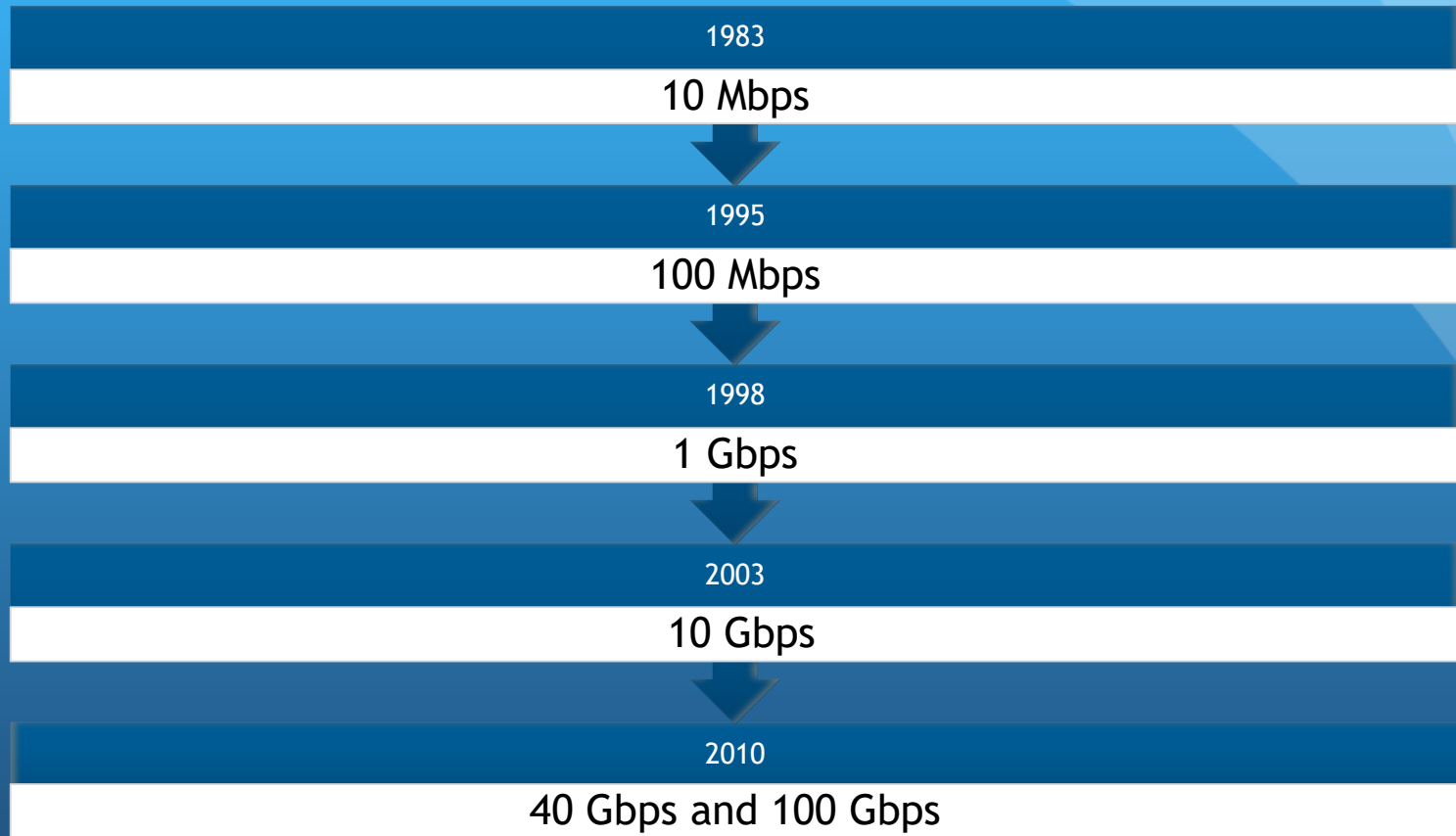
Standards

IEEE 802 LAN standards committee

- 802.3 group is responsible for issuing standards for LANs that are referred to commercially as Ethernet

The Ethernet Alliance supports and originates activities that span from incubation of new Ethernet technologies to interoperability testing to demonstrations to education

Ethernet Data Rates



- Currently Ethernet systems are available at speeds up to 100 Gbps

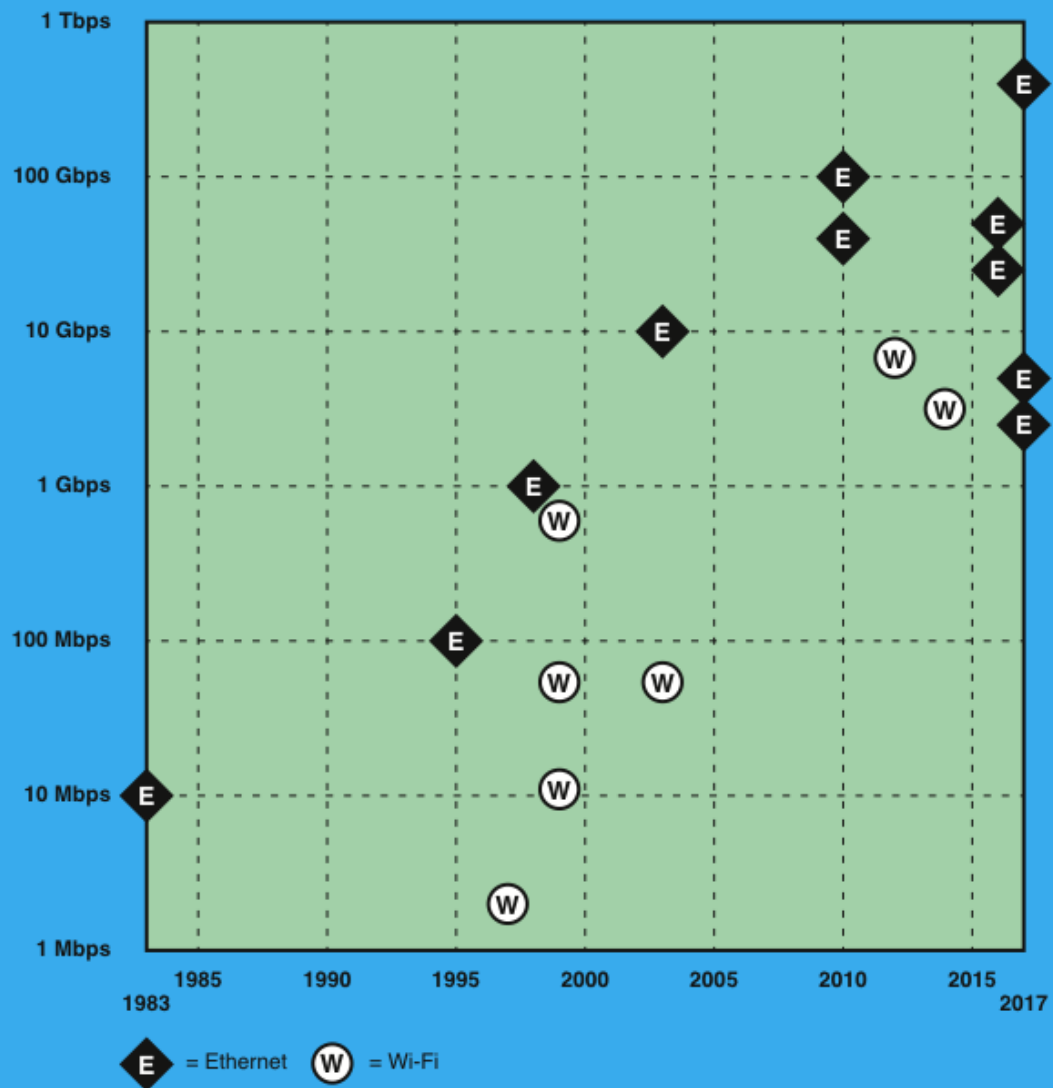


Figure 1.5 Ethernet and Wi-Fi Timelines

1-Gbps Ethernet

Centralized server farms

- In many multimedia applications there is a need for client systems to be able to draw huge amounts of data from multiple centralized servers, called server farms

High-speed local backbone

- As processing demand grows, enterprises develop an architecture of multiple LANs interconnected with a high-speed backbone network

Power workgroups

- These groups typically consist of a small number of cooperating users who need to exchange massive data files across the network
- Example applications are software development and computer-aided design

10-Gbps Ethernet

- The principle driving requirement for 10-Gbps Ethernet was the increase in intranet and Internet traffic
- Factors contributing to the explosive growth in both Internet and intranet traffic:
 - An increase in the number of network connections
 - An increase in the connection speed of each end-station
 - An increase in the deployment of bandwidth-intensive applications such as high-quality video
 - An increase in web hosting and application hosting traffic

100-Gbps Ethernet

- Market drivers for 100-Gbps Ethernet
 - Data center/Internet media providers
 - To support the growth of Internet multimedia content and web applications, content providers have been expanding data centers
 - Metro video/service providers
 - Video on demand has been driving a new generation of 10-Gbps Ethernet
 - Enterprise LANs
 - Continuing growth in convergence of voice/video/data and in unified communications is driving up network switch demands
 - Internet exchanges/ISP core routing
 - With the massive amount of traffic flowing through these nodes, these installations are likely to be early adopters of 100-Gbps Ethernet